Language Outcomes of Children with Cerebral Palsy aged 5 and 6 years: A Population-Based Study

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Abstract

AIM To examine the frequency, range and features of language impairment in a community sample of children with cerebral palsy (CP) aged 5 to 6 years.

METHOD Children with CP born between 2005 and 2007 were identified through the Victorian Cerebral Palsy Register. Eighty-four participants were recruited, representing 48% of the contacted families. The recruited sample was representative of non-participants. Participants completed standardised measures of receptive and expressive language, and non-verbal cognition.

RESULTS Language impairment was identified in 61% (51/84) of participants. Twenty-four percent (20/84) were non-verbal. Co-occurring receptive and expressive language impairment was common (44%, 37/84). Isolated receptive (7%, 6/84) and expressive (5%, 4/84) impairments occurred relatively infrequently. At a group level, verbal and non-verbal participants demonstrated deficits across language sub-domains (i.e., semantics, syntax, morphology), rather than in single domains. Cognitive impairment and GMFCS levels IV-V were associated with higher rates of language impairment, OR=15.2, 95% CI=3.2-71.8 and OR=8.5, 95% CI=1.8-40.3. Only cognition was independently associated with language impairment when both of these factors were considered within a multivariable model.

INTERPRETATION Language impairment was common in 5 and 6 year old children with CP, affecting 3 out of 5 children. Participants were impaired across linguistic sub-domains indicating a generalised language deficit. Findings suggest most children would benefit from a clinical language assessment. To target services effectively, sub-groups of individuals with CP at greatest risk for language impairment need to be identified.

What this paper adds:

1. Language impairment was common in a community cohort of children with CP aged 5 and 6 years: 3 out of 5 were impaired.
2. Receptive and expressive language impairments were often co-morbid, isolated impairments were rare.
3. Impairments within specific sub-domains of language (e.g., semantics, syntax) were not apparent, indicating a generalised language deficit.
4. Cognition was associated with language functioning.

Running foot: Language outcomes of children with CP

Language plays an integral role in facilitating daily activities and social participation, yet few population-based studies have examined the prevalence and features of language impairment in children with CP. An estimated 36-74% of children with CP experience some form of language impairment.[1-4] Comparisons across available studies are difficult however, due to differences in recruitment method (e.g., convenience vs. population-based samples), participant characteristics (e.g., age) and language measures.

Only one population-based study has estimated the prevalence of communication/language impairment.[1] This UK-based study involved registry obtained data of all known cases of CP born between 1980 and 2001 (n=1357). Communication impairment, defined as expressive speech and language difficulty, occurred in 37% of the cohort.[1] Estimates of language impairment based on standardised measures have been reported by two clinic-based studies using child-[3] or parent-completed[2] measures. Data from these studies suggests a higher frequency of language impairment compared to Parkes et al. For example, Voorman et al.[2] reported communication difficulties in 74% of children with CP with a mean age of 11 years (SD 1y 8mo, n=110) based on the Vineland Adaptive Behaviour Scales. Whereas in a sample of 36 children with spastic CP associated with prematurity and periventricular leukomalacia, ranging in age between 22 months and 9 years, the frequency of language impairment is estimated at 44%.[3] Despite the variability in language outcomes reported above, the above studies[1,3] and others[5,6,7] have demonstrated that language impairment within this population is often associated with impaired intellectual functioning amongst other factors.

Clinical speech and language management requires a detailed understanding of each child's strengths and weaknesses in speech, language and communication. Yet little is known regarding the specific language difficulties associated with CP. No population-based study has examined the occurrence of receptive versus expressive language impairment, or whether specific language sub-domains are likely to be differentially impaired. Language development involves learning to understand the rules of semantics (meaning of words and sentences), morphology (structure of words), syntax (structure of sentences), phonological awareness (sound structure of language), and social communication (social use of language). Understanding the specific level of language breakdown is key for accurate diagnosis and treatment.

Only two clinic-based studies[3,4] have dissociated children's receptive and expressive language outcomes. Findings suggest receptive and expressive impairments are common,[3,4] affecting comprehension, vocabulary, and grammar.[4] At a population-based level[5], the broad development of expressive language in young children (4-6 years) with CP has been described. Specifically, Sigurdardottir et al.[5] found that most children spoke in sentences/phrases as opposed to one-word utterances or communicating non-verbally. Finer grained analysis of receptive-expressive semantic, syntactic and morphological development has not been reported to date at a population level.

The present study aimed to further describe the language abilities of children with CP. Specifically, we examined the frequency, range and features of language impairment in a community sample of children with CP recruited through a population-based register. We also examined the interaction between cognition and language impairment to determine whether children demonstrated specific language deficits.

Method

Participants

Participants were recruited through the Victorian Cerebral Palsy Register (VCPR). The VCPR contains information about individuals with CP living or born in Victoria, Australia, since 1970. All children known to the VCPR born between 25 August 2005 and 24 August 2007 were eligible for study inclusion. This included those with post-neonatal injury occurring up to two years of age. The age range of 5 to 6 years was chosen since at these ages language development is considered less variable,[8,9] with ongoing refinement. It also represents a key time in Australian children's early learning as they are transitioning from kindergarten to primary school. Of the eligible participants identified (n=232), 176 (76%) were contacted (6 children had died, 50 were not contactable). Consent was obtained for 84 children, representing 48% of those contacted and 37% of the known living population of this age group in the VCPR (supplementary Figure S1). Ethics approval was obtained from Human Research Ethics Committees at The Royal Children's Hospital (#30048) and Southern Health (#11380), Melbourne.

Measures

Participants underwent a face-to-face assessment that included standardized measures of speech and language administered by the first author. Measures relevant to this study are described below.

The Preschool Language Scale-4[10] (PLS-4), a test of receptive and expressive language, was used to identify language impairment. Standard scores (mean 100, SD 15) were obtained for the Auditory Comprehension, Expressive Communication and Total Language subscales. Auditory Comprehension standard scores were not computed for two participants who required modifications to assessment procedures (e.g., eye gaze) as these can invalidate results. Age equivalent scores were calculated for non-verbal participants.

Language impairment was defined as a standard score >1 SD below the normative mean on the Expressive Communication and/or Auditory Comprehension subscales.[10] Language impairment was classified as isolated or mixed receptive-expressive. Standard scores were divided into severity ratings: mild (1-1.5 SD below the mean), moderate (1.5-2 SD below the mean) and severe (>2 SD below the mean).[11]

We examined features of language impairment using the PLS-4 'Profile' (completed for those identified with language impairment). The 'Profile' groups test items according to the language sub-domain it measures and provides the items age of acquisition. Impairment within a language sub-domain was identified if participants failed one or more age appropriate items.

The communicative abilities of non-verbal participants (i.e., those unable to verbally produce meaningful/comprehensible speech) were further measured using the Communication and Symbolic Behaviour Scales-Developmental Profile Caregiver Questionnaire[12] (CSBS-DP CQ). The questionnaire assesses a range of pre-linguistic skills and was completed by parents (n=17). The questionnaire was not returned for three participants. Although designed for children aged 6 to 24 months, the CSBS-DP can be used with older children functioning within this range.[12] The CSBS-DP CQ provides three composite scores measuring: expression of emotions and needs, gaze shifts, social interaction, and use of gestures (Social Composite); ability to communicate pleasure/displeasure, expressive vocabulary, and a listener's ability to understand the child (Speech Composite); and understanding of language and gestures, use of objects, and pretend play (Symbolic Composite).

To interpret a participant's CSBS-DP raw score, we devised a criterion to identify areas of strength relative to other non-verbal participants within the study group. An area of strength was defined as a cluster or composite score that was greater than or equal to the raw score at the 75th percentile of the 24 month norms. The next lowest percentile was used if no raw score was listed at this percentile. At 24 months, the 75th percentile represents the high average range of functioning. Thus, we used this cut-point as a way of identifying non-verbal participants with higher functioning communicative abilities. Participant's approximate age equivalency was determined by using the age band where the normative mean corresponded to the participant's raw score.

The PPVT-4,[13] a measure of receptive vocabulary, was completed by 5 (25%) non-verbal participants and 25 (39%) verbal participants. It was an optional component of the battery for verbal participants, administrated when participants were not fatigued. A cut-point of >1SD below the mean (100, SD 15) was used.

The Gross Motor Function Classification System (GMFCS)[14] and Columbia Mental Maturity Scale (CMMS) measured gross motor function and non-verbal cognition, respectively.[15] When participants were unable to complete the CMMS due to severe intellectual disability, fatigue or vision impairment (n=33), cognitive impairment was based on data collected by the VCPR (IQ <70).

Statistical Analysis

To determine the representativeness of the sample, participants were compared to non-participants (i.e., children eligible for study inclusion but did not take part, excluding six children who had died). Chi-square analysis was used to test if the distribution of categorical variables differed between participants and non-participants, assuming a 5% level of significance. Variables compared were gender, motor type and distribution, GMFCS level, epilepsy, cognition, hearing and vision.

Language data were analysed across all participants and within the verbal and non-verbal subgroups, and mono- and bilingual subgroups. Uni- and multivariable logistic regression analyses examined the association between language (outcome variable), cognitive impairment and GMFCS levels (reference group: levels I-II) (explanatory variables).

Results

Participants (47 male, 37 female) were aged between 4y 11mo and 6y 6mo (mean 5y 7mo, SD 6mo). Participants did not significantly differ to non-participants in terms of CP type and distribution, GMFCS level, and the presence of epilepsy, hearing, vision and cognitive impairment (Table I). Fourteen participants (17%) were from a non-English speaking background.[1]

Ten participants were not included in the regression analyses (cognitive status was unknown for eight and PLS-4 standard scores were not available for two). PLS-4 standard scores were unavailable as one participant had a significant vision impairment (Figure S1) and the other participant completed the PLS-3 with their local therapist but a ceiling was not

[1] Turkish, Arabic, Persian, Harari, Amharic, Oromo, Somali, Konkani, Greek, Japanese, Serbian, Sinhalese, Indonesian, Mandarin, Telugu and Bengali.

reached. Results for the participant who completed the PLS-3 were used in analyses examining the features (and not the frequency) of language impairment.

Insert Table I about here

Frequency & Range of Language Impairment

Receptive and/or expressive language impairment was identified in 61% (51/84) of verbal and non-verbal participants using the PLS-4 and, in one case, the Clinical Evaluation of Language Fundamentals-4 (CELF-4; a measure of expressive and receptive language). Twenty-four percent (20/84) were non-verbal. Thirty-seven percent of participants demonstrated age appropriate language abilities (31/84). The presence of language impairment was unable to be confirmed in two participants. Mixed receptive-expressive language impairment occurred in 44% (37/84) of the total sample and in 73% (37/51) of the language impaired group. This was followed by isolated receptive (7%, 6/84) and expressive impairment (5%, 4/84). Type of language impairment was not determined for four participants (three non-verbal) as a standard score was computed for only one PLS-4 subscale. This was due to the use of eye gaze during the Auditory Comprehension subscale (n=2) or the child not responding to questions (n=2). All four participants demonstrated impaired language functioning in the completed subscale.

Mean Auditory Comprehension and Expressive Communication scores were >1 SD below the mean for the total sample and within 1 SD for verbal participants. Variability in performance was evident across the cohort (Tables II, III). Forty-four and 50 percent of verbal participants demonstrated mild receptive and expressive language impairments (respectively), as opposed to 37% and 42% who demonstrated severe receptive and expressive impairments (respectively; supplementary Table S1). Based on the PLS-4, mean scores for non-verbal participants suggest little variability in language abilities (Table II) and all showed severe receptive language impairment (Table S1).

Insert Tables II and III about here

Cognitive impairment was associated with an increased odds of language impairment (OR=15.2, 95% CI=3.2-71.8, p=0.001). Co-occurring language and cognitive impairment was evident in 30% of participants (22/74). Language and cognitive profiles are illustrated in Figure S2. Language outcomes in relation to GMFCS level are shown in Table IV. For the logistic regression analyses, GMFCS levels I and II were combined as well as IV and V. Logistic regression analyses estimated that GMFCS levels IV-V were associated with language impairment (OR=8.5, 95% CI=1.8-40.3, p=0.007). A statistically significant association was not evident between GMFCS level III and language impairment (OR=0.6, 95% CI=0.2-2.2, p=0.4). In the multivariable model, only cognitive impairment was independently associated with language impairment (OR=13.4, 95% CI=2.6-68.3, p=0.002; GMFCS levels IV-V: OR=4.4, 95% CI=0.8-24.2, p=0.09). This finding remained when non-verbal participants were excluded from the analyses (cognition: OR=12.7, 95% CI=2.1-76.0, p=0.005).

Insert Table IV about here

Bilingual verbal participants scored approximately 1 SD below the mean of monolingual verbal participants (Table S2). Mono- and bilingual participants demonstrated relatively similar non-verbal cognitive scores (Table S3).

Features of Language Impairment

Participants' performance on the sub-domains measured by the PLS-4 (Table S4), PPVT-4 and CSBS-DP CQ (Table III) are described below.

Receptive Language

Non-verbal participants.

Items within the PLS-4 sub-domains of attention to environment and people were correctly completed by 84% (16/19) and 63% (12/19) of non-verbal participants, respectively. Comprehension of gestures was the area of most difficulty (68%, 13/19). All had deficits in receptive language structure, with the exception of one participant who had appropriate understanding of morphological markers. Receptive semantic deficits were pervasive (19/19). The mean age equivalent for the Auditory Comprehension subscale (n=17) was 15 months (SD 14, range 0 to 44 months). Of the four participants where a PPVT-4 standard score was computed, one had age appropriate receptive vocabulary. PPVT-4 scores ranged from 40 to 90.

Verbal participants.

All 27 verbal participants with language impairment had receptive semantic deficits. Receptive language structure and integrative language (i.e., ability to categorise, organise and interpret information) impairments were common, seen in 93% (25/27) and 63% (17/27) respectively. Comprehension of syntactic structures (93%, 25/27) was more often affected than morphological markers (48%, 13/27). Receptive semantic errors commonly involved comprehension of quantitative concepts (96%, 26/27) and vocabulary (70%, 19/27). However, comparison of PLS-4 and PPVT-4 receptive vocabulary results revealed that two participants who demonstrated impairments in this area on the PLS-4 demonstrated age appropriate abilities on the PPVT-4.

Expressive Language

Non-verbal participants.

All non-verbal participants had social communication deficits measured by the PLS-4. Items on the use of gestures were passed by 70% (14/20). A lower proportion demonstrated strengths in the Gestures cluster of the CSBS-DP (53%, 9/17). A small number of participants demonstrated strengths in other CSBS-DP clusters/composites: Emotion and Eye Gaze (5/17), Understanding (3/17), Communication (2/17), Object Use (2/17), Social Composite (2/17), and Symbolic Composite (1/17).

The mean age equivalent for the PLS-4 Expressive Communication subscale was 12.7mo (SD 5.2, range 5 to 22mo). The CSBS-DP indicated that 29% (5/17) and 18% (3/17) had social and symbolic abilities, respectively, greater than a two year old (Figure S3).

Verbal participants.

Many participants had language structure deficits involving syntax and morphology (87%, 20/23) and all demonstrated semantic deficits. A high percentage had appropriate expressive vocabulary (96%, 22/23) and spatial concepts abilities (83%, 19/23).

Discussion

Here we describe the frequency, range and features of receptive and expressive language impairment in a population-based sample of children with CP. Previous estimates of language impairment have been based on non-standardized measures[1] or clinical samples[2-4] and have often been combined with other areas of communication (e.g., speech,[1] literacy)[2] making it difficult to ascertain the precise prevalence of language impairment. We found, in a representative population sample and using face-to-face administered standardised measures, that both receptive and/or expressive language impairments were common (61%).

In terms of the features of language impairment, verbal participants demonstrated difficulties across all PLS-4 sub-domains (i.e., semantics, language structure, social communication, integrative language skills and phonological awareness). Although, some relative strengths and weaknesses were noted in relation to the verbal participants' receptive language skills, where integrative skills were stronger than language structure skills. The language profile seen here is different to language impairment not associated with a physical disability. For example, children who are otherwise typically developing with a language impairment have been found to have greater problems in syntax or morphology relative to semantics.[16,17] Our finding is, however, similar to that seen in children with intellectual disabilities where vocabulary and syntax abilities have been found to be below average.[18] The association between cognition and language reported here may explain the impairments seen across language sub-domains rather than within a specific linguistic area.

Cognition (and not GMFCS level) was independently associated with language impairment. Although our finding has been reported in relation to communication[19] and receptive language,[7] others have found that both GMFCS level and cognitive impairment are independently associated with communication[1]. Further, there are instances where an association between GMFCS level and receptive language has been reported in the absence of cognitive data.[20] Overall, whilst there is growing evidence of the impact of cognitive level on communication in this population, further work is needed to pinpoint the specific cognitive deficits that contribute most to language to assist in developing targeted interventions. Whilst we did not examine the association between language and CP motor type, participants' poor receptive language may be due to the majority having a spastic dominant motor type, which has been associated with reduced language outcomes.[20]

Whilst the PLS-4 is a comprehensive assessment, it does not measure in-depth each sub-domain as would a domain-specific measure (e.g., the PPVT for testing receptive vocabulary). Further, the PLS-4 does not provide a standard score for each language sub-domain. Participants were identified as having difficulty within a sub-domain if they failed ≥1 age appropriate items within that section. This may have led to an overestimation of impairments within and across sub-domains.

It has been suggested that children with CP who are largely non-verbal, with severe dysarthria or anarthria, are more likely to demonstrate receptive vocabulary deficits as opposed to receptive grammar/syntax,[21,22] although the reverse has also been reported.[23] Based on the PLS-4, we found no evidence to suggest that non-verbal children with CP are more likely to demonstrate impairments within a specific sub-domain of receptive language, although further exploration of this area would have been possible had a higher number of participants been able to complete the PPVT-4. Results from the CSBS-DP did, however, reveal that non-verbal participants were more likely to demonstrate strengths on clusters within the Social composite (i.e., Emotion and Eye Gaze, and Gesture) than those within the Symbolic composite (i.e., Understanding and Object Use). This is consistent with the communication profiles of children with CP at 24 months.[24] This finding possibly reflects children's fine motor limitations since most items within the Symbolic composite are motor-based.[24]

The severity of receptive and expressive language impairments has not been previously examined using standardised language measures. Verbal and non-verbal participants had a range of severity scores, from mild to severe. For non-verbal participants, the PLS-4 revealed little variability in receptive language abilities, although standard scores reported here do not reflect more higher-functioning participants, n=2, who required modifications to test procedures. By contrast, CSBS-DP results showed variability in social and symbolic abilities. Whilst the PLS-4 does measure pre-linguistic skills, our results suggest that the CSBS-DP may be more suitable for detecting differences in the communicative abilities of non-verbal children with CP at 5 and 6 years of age. This may reflect the different areas these tools measure and their sampling procedures e.g., the PLS-4 is more focused towards language function whereas the CSBS-DP relates to communication activity based on spontaneous interactions.

Whilst not the study's primary focus, we note bilingual participants had poorer language outcomes than monolingual participants, which was not explained by differences in cognition. This was unexpected since research suggests acquiring two languages simultaneously does not disadvantage language development.[25,26] Unfortunately, data regarding daily exposure to English were not obtained here and first language proficiency was not confirmed to clarify whether participants presented with a language difference or impairment. These data could potentially explain our findings.

Study Limitations & Implications

A study strength is that language outcomes were based on face-to-face standardised measures. The cut-off for language impairment used here (>1 SD below the mean) may be considered slightly liberal compared to >1.25 or >1.5 SD. Some may argue that this could potentially result in an overestimation of language impairment. The cut-off adopted here is consistent with the common clinical gold standard[27] although children may not receive treatment in the absence of a verbal-nonverbal split. Since many items within the PLS-4 require a fine motor response, results reported here may underestimate children's abilities. The development of language tools that require minimal motor response[20] may shed further light on children's abilities. Expressive language analyses based on spontaneous language samples may eliminate the impact that impaired mobility and vision may have on children's ability to complete standardised tests. A final limitation is the participation rate (48% of contacted families). Whist participants and non-participants did not significantly differ, it is possible that they may have on variables not considered here. The VCPR systematically collects data regarding comorbidities from medical records, with variable reporting of data a possibility.

Findings suggest most children with CP would benefit from a clinical language assessment during early childhood to identify and manage receptive and/or expressive deficits. Only lower levels of evidence currently support the effectiveness of language interventions for this population.[28] Considering that language impairment was identified as a common comorbidity of CP, there is a need for higher levels of evidence to establish which interventions are associated with the greatest gains and for which children. Factors contributing to children's language profiles (e.g., CP type, speech, hearing and vision impairment) would provide needed information to support effective targeting of speech pathology services.

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Table I: Characteristics of participants (n=84) and non-participants (n=142)

	Participants n (%)	Non-participants n (%)	*p* value
Gender			
Female	37 (44)	59 (42)	0.71
Male	47 (56)	83 (58)	
Motor Type			
Spastic	66 (79)	118 (83)	0.79
Dyskinesia	1 (1)	1 (0.7)	
Hypotonia	3 (4)	4 (3)	
Ataxic	1 (1)	2 (1)	
Mixed	13 (15)[a]	15 (11)	
Unknown	0 (0)	2 (1)	
Distribution			
Monoplegia	1 (1)	2 (1)	0.60
Hemiplegia	32 (38)	55 (39)	
Diplegia	25 (30)	42 (30)	
Triplegia	1 (1)	3 (2)	
Quadriplegia	25 (30)	38 (27)	
Unknown	0 (0)	2 (1)	
GMFCS			
I	33 (39)	52 (37)	0.39
II	15 (18)	33 (23)	
III	13 (15)	11 (8)	
IV	16 (19)	21 (15)	
V	7 (8)	14 (10)	
Unknown	0 (0)	11 (8)	
MACS			
I	30 (36)	-	
II	29 (35)	-	
III	12 (14)	-	
IV	7 (8)	-	
V	6 (7)	-	
Cognitive impairment			
No	54 (64)	54 (38)	0.07
Yes	22 (26)	40 (28)	
Unknown	8 (10)	48 (34)	
Vision impairment			
No	56 (67)	63 (44)	0.21
Yes	28 (33)	46 (32)	
Unknown	0 (0)	33 (23)	
Hearing impairment			
No	78 (93)	100 (70)	0.06
Yes	6 (7)	18 (13)	
Unknown	0 (0)	24 (17)	
Epilepsy			
No	65 (77)	100 (70)	0.73
Yes	18 (21)	35 (25)	
Resolved	1 (1)	1 (1)	
Unknown	0 (0)	6 (4)	

GMFCS: Gross Motor Function Classification System. MACS: Manual Ability Classification System. All data (except GMFCS and MACS for the participant group only) were obtained from the Victorian Cerebral Palsy Register (VCPR). Vision impairment was defined as blindness (vision worse than 6/60) or visual acuity reduced to the extent that corrective lenses are required. Hearing impairment was defined as hearing loss greater than 40db in the better ear or bilateral deafness (hearing loss greater than 70db in the better ear). Cognitive impairment was defined as an IQ <70. In cases where hearing, vision or epilepsy data were missing, parent report was utilised. In cases where cognitive status was unknown, the child's score from the Columbia Mental Maturity Scale was used to determine intellectual functioning. MACS levels were not compared across the two groups due to the high percentage of missing data on the VCPR.

[a] Dominant motor type was spastic (11/13), hypotonia (1/13) and ataxia (1/13).

Table II: Auditory Comprehension, Expressive Communication and Total Language scores derived from the Preschool Language Scale-4 (PLS-4) and Columbia Mental Maturity Scale (CMMS)

	n	Age appropriate n (%)	Mean	SD	Range
Language (PLS-4)					
Entire cohort[a]					
Auditory Comprehension	78	35 (45)	80.1	22.3	50-117
Expressive Communication	80	37 (46)	79.2	22.3	50-122
Total Language	77[b]	36 (47)[c]	79.6	22.5	50-177
Verbal participants					
Auditory Comprehension	61	35 (57)	88.2	18.2	50-117
Expressive Communication	60	37 (62)	89.0	16.8	50-122
Total Language	60	36 (60)	87.9	18.2	50-117
Non-verbal participants					
Auditory Comprehension	17	0 (0)	51.1	4.4	50-68
Total Language	17	0 (0)	50.3	1.2	50-55
Cognition (CMMS)					
Entire cohort	50	41 (82)	98.0	13.5	72-128
Verbal participants	49	40 (82)	98.2	13.6	72-128
Non-verbal participants	1	1	86	-	-

n values vary as not every child completed each subscale. Results for the child who completed the CELF-4 are not included in this table.

[a] PLS-4 results for one participant were obtained from their clinical assessment report to avoid practice effects. A second participant's language outcome was based on their clinical assessment using the Clinical Evaluation of Language Fundamentals-4,[11] which measures similar constructs to the PLS-4. [b] Total Language score was not computed for four children due to a standard score being computed for only one subscale. [c] Five children were identified as having a receptive or expressive language impairment.

Table III: Communication and Symbolic Behaviour Scales-Developmental Profile Caregiver Questionnaire (CSBS-DP CQ) raw scores for non-verbal participants (n=17)

Cluster/Composite	Maximum score	Mean	SD	Range	Median	IQR
Social Composite	48	32.1	12.0	6-48	35	24-40
Emotion and Eye Gaze	16	11.4	3.2	3-16	12	12-14
Communication	20	12.4	5.2	3-20	13	9-16
Gestures	12	8.2	4.5	0-12	11	5-12
Speech Composite	40	9.8	10.9	1-36	6	2-10
Sounds	16	5.9	4.3	1-13	4	2-10
Words	24	2.7	5.6	0-23	0	0-4.5
Symbolic Composite	51	25.3	16.2	2.5-50	21.5	12-38
Understanding	24	12.9	8.9	1-24	11	6.5-20
Object Use	27	12.3	8.9	0.5-26	11	3-19.5
Total	139	67.2	32.6	11.5-119	66.5	37-91.5

IQR: interquartile range.

Table IV: Language outcomes and GMFCS level

	GMFCS level (explanatory variable) *n (%)*					
	I	II	III	IV	V	*p* value
Outcome variables:						
Language impairment:						
Age appropriate	16 (52)	6 (19)	7 (23)	2 (6)	0 (0)	0.02
Impaired	17 (33)	9 (18)	5 (10)	13 (25)	7 (14)	
Communication method:						
Verbal	33 (52)	13 (20)	12 (19)	6 (9)	0 (0)	<0.001
Non-verbal	0 (0)	2 (10)	1 (5)	10 (50)	7 (35)	
Severity of language impairment:[a]						
Mild	4 (50)	1 (13)	2 (25)	1 (13)	0 (0)	<0.001
Moderate	6 (86)	0 (0)	1 (14)	0 (0)	0 (0)	
Severe	4 (15)	5 (19)	1 (4)	10 (38)	6 (23)	

P value calculated using the chi-square test.

[a] Subgroup of children with language impairment.